Gheorghe Gâță, Alexandru Dragoman

THE NEOLITHIC POTTERY FROM VĂDASTRA: A TECHNOLOGICAL STUDY

Introduction

With few exceptions[1], both in Romania, and in Bulgaria, most studies on the Vădastra pottery were dominated by the typo-chronological method[2]. As they were mainly interested in the chronological stages of pottery development, Romanian archaeologists have used evolutionary concepts and ethnic interpretations for analysing the Vădastra material. The core of the approach has been the principle of 'pottery style = chronology = culture = ethnic group'[3]. In the present article we wish to tackle some aspects on the Vădastra pottery manufacture. These aspects have largely been ignored by Romanian archaeologists *viz.* clay sources, pot modelling, firing and so on.

Site location (Fig. 1)

The Neolithic settlement of Vădastra–*Măgura Fetelor* lies in the south of Romania, in the Oltenian Plain (part of the Romanian Plain), 14 km north-west of the town of Corabia, on a hill named by locals Dealul Cişmelei. It stands on the Băileşti

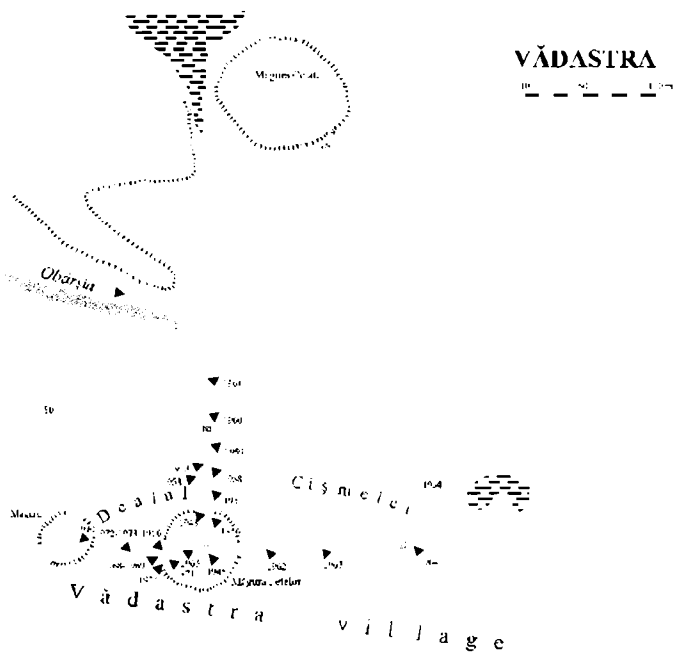

Fig. 1. Location of the area of study (redrawn after Gâță and Mateescu 1992a, Pl. I).

[1] E.g. Gâță, Mateescu 1992a; van As *et al.* 2005.
[2] E.g. Nestor 1932, p. 56-57; Berciu 1939, p. 37-49; 1961, p. 50-58; 1966, p. 93-98; Nica 1970; 1971; 1976; 1997; Nica, Ciucă 1986, p. 66 ff.; 1989, p. 29 ff.; Elenski 1998; Comşa 1998-2000; Naidenova 2000; 2005; Gherghov 2001; Boroneanț 2005.
[3] Ellis 1996, p. 76.

terrace, one of the medium terraces of the Danube. To the north Dealul Cişmelei is bordered by the Obârşia stream flowing from west to east[4]. Today, *Măgura* is almost round-shaped with a north-south diametre of 54.50 m and the east-west one of 50.50 m and a height of 1.40 m. The altitude from the sea level is 82.50 m and 12-14 m above the Obârşia stream meadow[5].

State of research

As resulted from the excavations reports, the main goal of those who conducted the excavations in the settlement of Vădastra–*Măgura Fetelor* was establishing and later checking the relative chronology of the site. The settlement was first surveyed by Vasile Christescu in 1926[6]. As Christescu's excavations failed to lead to any conclusions from a stratigraphical point of view, in 1934 Dumitru Berciu conducted new surveys[7], that led to the identification of two Neolithic layers which he named Vădastra I (characterized by channelled pottery) and Vădastra II (characterized by excised pottery). According to Berciu one cannot make a clear distinction between the two layers. The pottery decorated with channellings occurs also in the lower levels of layer II, where it associates with the excised pottery, but later decreases and vanishes[8]. The excavations were resumed in 1946 by Corneliu N. Mateescu, who continued the researches – with some interruptions – until 1974[9]. The anthropogenic deposits are about three meters thick in the center of the hillock, getting thinner and thinner (till 0.50 m thick) as the hillock gets farther. Mateescu provided the following stratigraphic sequence:

1. Paleolithic layer with a maximum thickness of 0.60 m[10].
2. 'Medium layer' with no archaeological material – with a maximum thickness of 0.45-0.50 m.
3. Vădastra I layer (Neolithic): 0.40-0.04 m thick, pervaded by many later pits (Vădastra II: some of them are 3.50 m in diameter and 1.50 m deep), the very reason why the material is mixed to a large extent. In this layer he uncovered 'pit-houses', pits, as well as a ditch suposed to have surrounded the settlement.
4. Vădastra II layer (Neolithic): 0.80-0.06 m thick and could have had more levels, that were not noticed. In this layer he uncovered a two-room house with a verandah built of a pole skeleton with wattle bound with clay, remains from other destroyed houses built in the same way, many pits, a kiln etc.
5. Sălcuța layer (Copper Age) with a thickness of 0.65-0.05 m. On *Măgura Fetelor*, the upper part of this layer has been destroyed by ploughing and erosion.
6. Mediaeval Age dwelling traces: the XIVth, XVIIth and XVIIIth centuries[11]. The lower part of this layer has been preserved on the terrace.

The analyses of the soil samples taken from the excavations conducted in 1965 on *Măgura Fetelor*[12] proved that, from top to bottom, in the culture layers the clay ranges between 20 and 33 %. The loess in the 'medium layer', the Paleolithic one and that from the 'live soil' is richer in clay (the proportion is 33 %) than that in the Neolithic layers. At the same time, the plasticity ratio of the 'medium layer' and of the Paleolithic one has

4 Mateescu 1970b, p. 67.
5 Mateescu 1970a, p. 52.
6 Christescu 1927-1932, p. 169-205.
7 Berciu 1934, p. 75-79; 1937, p. 1-9.
8 Berciu 1937, p. 4.
9 Mateescu 1949; 1959a; 1959b; 1961a; 1961b; 1962a; 1962b; 1965; 1970a; 1970b; 1970c; 1972; 1973; 1978; Protopopescu-Pake *et al.* 1969, p. 136-149.
10 See Păunescu 1999-2000 with the previous literature.
11 See Mateescu 1960; 1963; 1968; 1970d; Mateescu, Comănescu 1972; 1973; Comănescu, Mateescu 1970; 1970-1971.
12 Protopopescu-Pake *et al.* 1969, p. 151-152.

higher values (16.0 %-18.5 %) by comparison with the values obtained for the Neolithic layers (12.5-15.5 %). All that made the auhtor of the excavations believe that many identified pits were dug during the Neolithic in order to draw out clay for the manufacturing of vessels[13]. In this article we are going to prove that this assertion cannot be maintained.

According to Mateescu, the Vădastra I layer is characterized by fine black/ greyish pottery decorated with channellings or with incised bands with dots filled with white paste (the so-called Vinča style), while the Vădastra II layer is characterized by black/brown pottery decorated with excised motifs. Therefore, he divided the 'Vădastra culture' in two phases (I and II). On some fragments found in the upper part of the Vădastra I layer the decoration made up of channellings is associated with excised decoration. The surface-roughened ware occurs in both layers.

Despite the informations published by Mateescu, we should keep in mind that the above mentioned pottery groups might be contemporaneous. Following the excavations conducted at Hotărani, Berciu and Marin Nica stated that the old name of Vădastra I and Vădastra II no longer renders the reality and that channelled black and grey pottery occurs in all the layers[14]. At the same time, starting from his excavations (e.g. at Fărcaşu-de-Sus) Nica observed that in the first phase of the so-called Vădastra culture, channelled pottery and the excised one coexist and that sometimes the excised decoration is combined with the channelled one on the same pot[15]. Unfortunately, all these datings are based on the stylistic analysis of the materials without presenting in detail the contexts where they have been found. Good contextual data come from the recent excavations carried out by a British-Romanian team in the Teleorman River Valley: for instance, one of the Vădastra features (C 22) found at Măgura–*Buduiasca* (Teleor 003) contains both channelled and excised pottery[16].

We believe that more secure informations could be obtained by direct dating of Neolithic pottery[17] or by relating the pottery with the C-14 datas from the same contexts. As an example, in the case of pottery deposited in a sacrificial fen at the Funnel-Beaker site of Skogsmossen (central Sweden), 15 AMS-datings of organic remains on potsherds have suggested that the design of the pottery had been more dependent on social rather than on chronological factors[18]. As Johannes Müller has noted for the Neolithic and Early Bronze Age pottery from Central-Elbe-Saale region, '[...] stilistisch-typologische Beobachtungen sind nicht nur chronologisch, sondern als Teile sozialer Zeichensysteme zu bewerten. Erst mit typologien-abhängigen Datierungsmethoden sind diese typologisch-stilistischen Inventargruppen chronologisch einzuordnen und Zeitphasen zuzuordnen.'[19]

Chronology

On the basis of the excavation results a series of synchronisms were established. In the first Neolithic layer Mateescu found Boian-Bolintineanu pottery and a few fragments belonging to the Linear Pottery with Musical Notes (*Notenkopf*). In the second Neolithic layer the author of the excavation found Boian-Giuleşti sherds. Although until now there is only one radiocarbon date for the Vădastra-*Măgura Fetelor*

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[13] E.g. Protopopescu-Pake *et al.* 1969, p. 151, p. 152; Mateescu 1965, p. 260; 1970a, p. 56, p. 58; 1970b, p. 70, p. 71.
[14] Berciu 1966, p. 97; Nica 1971, p. 31.
[15] E.g. Nica 1976, p. 94, p. 96.
[16] Andreescu, Bailey 2005, p. 225.
[17] See Bonsall *et al.* 2002.
[18] Hallgren, Possnert 1997.
[19] Müller 2000, p. 119.

site, from Vădastra II layer[20], we mention that in his book on the Neolithic and Copper Age houses in south-east Europe, Clemens Lichter assigned the house uncovered in the eponymous settlement to *Datierungsgruppe 2*, that is 5500-4700 CAL. BC[21]. On the basis of corroborating the data on the relative chonology and the existing radiocarbon data for other Neolithic sites at the Lower Danube, the Vădastra settlements were dated between 5200 and 4900 CAL. BC[22].

Analytical methods

The present article is based on the tests performed on 1172 diagnostic sherds and fragmentary vessels selected by Mateescu from the excavations he conducted at Vădastra. They derive both from the Neolithic layers, and from various identified features. For the sake of comparison 43 figurines (9 from Vădastra I contexts and 34 from Vădastra II contexts) have been also analysed[23].

The average thickness of the sherds was determined by the value obtained as an arithmetic average of all the individual measurements made with the gauge, with a 0.1 mm precision[24]. The porosity was determined by a 24 hour water absorption and expressed in percentages as related to the initial weight of the pottery fragments.

Two indexes were calculated: the porosity index and the modelling one. The porosity index was calculated as a porosity/average sherd thickness ratio. It estimates the amount of vegetal mass added to the paste. The modelling index was calculated as a standard deviation of the individual measurements of the average thickness, and is an estimation of the evenness of the thickness of the sherd walls. The results of the physical tests and of the indexes were used for selecting the sherds for chemical tests, X-ray diffraction tests and infrared absorption tests. 138 chemical tests were performed of some extracts in hydrochloric acid 6N treating one gram sample – thoroughly cut into pieces – with 20 ml hydrochloric acid. The solution was kept for an hour on boiling water by stirring from time to time, filtered immediately, and washed with 5 % hydrochloric acid until collecting 100 ml. magnesium, calcium, strontium and iron were dosed by atomic absorption. The X-ray diffraction patterns were obtained by always using the same conditions of the equipment. 231 pottery samples and sources were broken up roughly and deposited on glass blades. The intensities of the lines from 4.26 KX (quartz) to 3.03 KX (calcite) were measured and the ratio of these lines was calculated. The infrared absorption analyses were performed by using the technique of the potassium bromide disks at a dillution of 1 mg sample in 300 mg potassium bromide. Kaolinite occurred in the case of 138 samples (out of 231). Clay fractions under 0.002 mm were separated from 14 presumptive sources by dispersion in water with NaOH up to the pH 9 and their mineralogical composition was determined by using orientated preparates[25]. Particle size analyses of the presumptive sources were carried out by the Khacinski method[26].

[20] Mateescu 1978, p. 65, footnote 9.
[21] Lichter 1993.
[22] Mantu 1999-2000, p. 101, table 2.
[23] About some figurines found at Vădastra see Voinescu, Mateescu 1980; Mateescu, Voinescu 1982. For the use of white paint or ochre in decorating the figurines (and pottery) see Gâţă, Mateescu 1987; 1992b; 1999-2001.
[24] Gâţă *et al.* 1997.
[25] Gâţă 1972.
[26] Moţoc 1964.

Ceramics

Surface treatment and decoration

According to the surface treatment, we divided the analysed pottery into three categories:

A. PLAIN BURNISHED WARE (Fig. 2: 1)

All the fragments in this group were tempered with vegetal material; the paste always contains quartz and white mica foils (both on the inside, and on the outside) originating from the clay sources. Many of the fragments are burnished/polished both on the outside and on the inside. Other sherds are burnished/polished on the outside and smoothed on the inside. Colours: exterior – black (10YR 2/1), yelowish brown (10YR 5/8), dark gray (7.5YR 4/0); interior – black (10YR 2/1), grayish brown (10YR 5/2), dark reddish gray (5YR 4/2).

B. DECORATED BURNISHED WARE

The fabric and the surface treatment are similar to the plain burnished ware. The decoration techniques are:

Channellings/plissé (Fig. 2: 2)

Almost each time they cover only the upper part of the pot. The channellings/*plissé* are vertical, horizontal, oblique or semi-circular. Sometimes, the part under the rims of the pots is painted with red ochre. Often, the channelled motifs are associated with *impresso* motifs (carried out with an object): small impressions on the maximum diameter of the vessel or triangles – filled with impressions – situated between the channelled motifs. On the necks of some fragments (always uncovered in the upper part of the Vădastra I layer: cf. Mateescu), channelled decoration is combined with a row of rhombs carried out by the excision technique (Fig. 2: 3). The colours are the same with those for the plain burnished ware.

Excision (Fig. 2: 4)

The excised motifs are combined with incised and grooved ones. The decorative elements are meanders, spirals, rhombs and rectangles, covering most of the pot. The spaces between the motifs were filled with white paste in a sharp contrast to the dark background[27]. Like in the previous group, on the part under the rim and on the bottoms of some of the pots red ochre paint traces have been preserved[28]. Some of the fragments are decorated both on the outside and on the inside. The pots decorated in this way must have had a strong visual impact upon the viewer, as the techniques and colour contrast (white and red on a dark background) were obtained deliberately. Colours: exterior – black (10YR 2/1), yellowish brown (10YR 5/4), gray (7.5YR 5/1); interior – black (10YR 2/1), light brownish gray (10YR 6/2), dark gray (10YR 4/1).

Incision

1) Shallow incisions rendering motifs characteristic of excised pottery (henceforth IN/EX) (Fig. 2: 5). Colours: exterior – black (10YR 2/1), light yellowish brown (10YR 6/4), pinkish gray (7.5YR 6/2); interior – black (10YR 2/1), pale brown (10YR 6/3), dark gray (10YR 4/1).

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[27] Gâță, Mateescu 1987; 1992b.

[28] Gâță, Mateescu 1999-2001.

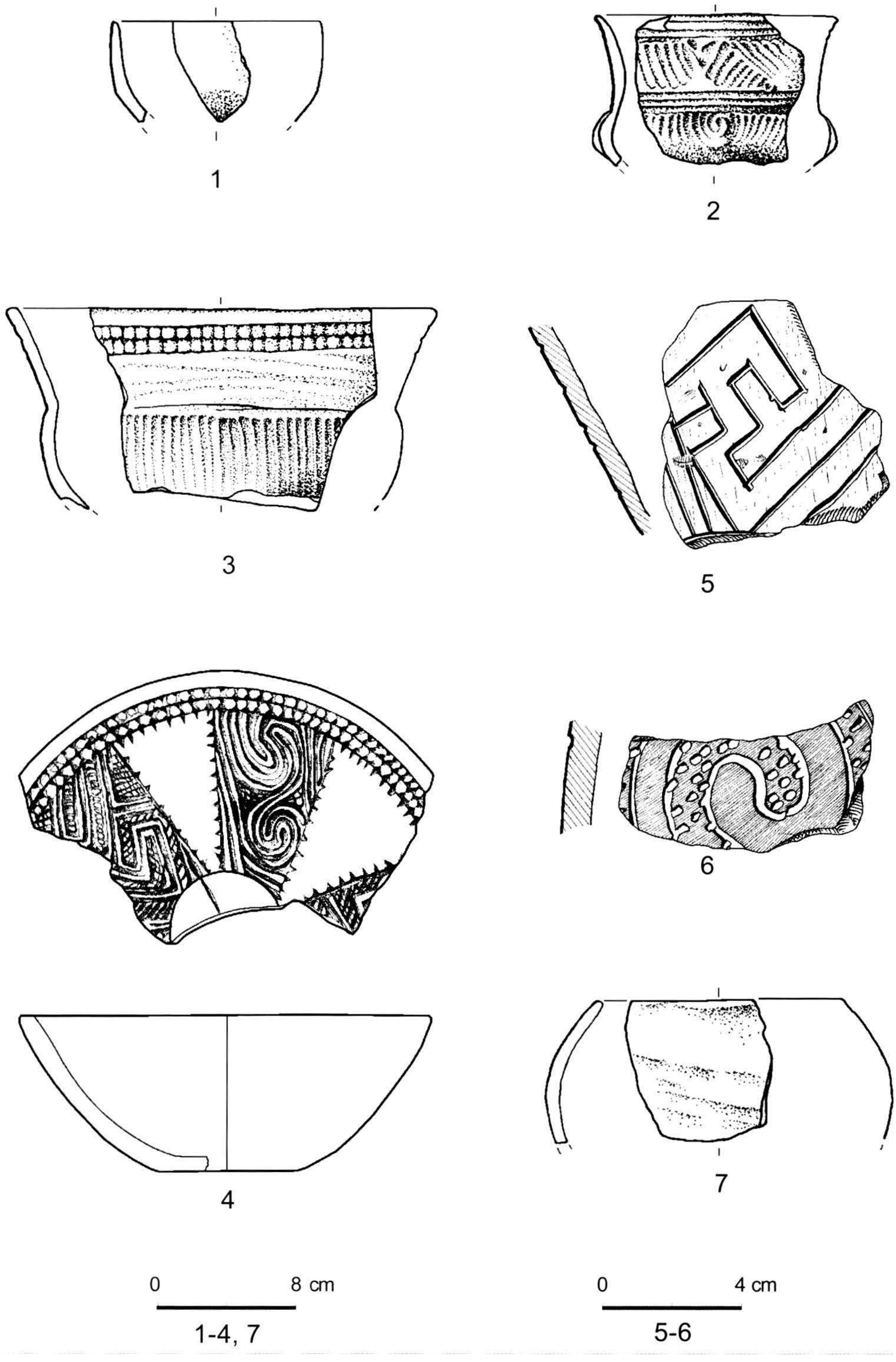

Fig. 2. Vădastra. Plain burnished ware (1); Decorated burnished ware (2-6); Surface-roughened ware (7).

2) Incised bands filled with dots – the so-called Vinča style (Fig. 2: 6). The incisions and impressions are filled with white paste that – also here – contrast with the dark background of the pots. Some of the fragments are decorated both on the outside and on the inside. On some sherds, the 'Vinča style' decoration is combined with excised motifs. Colours: exterior – black (10YR 2/1), grayish brown (10YR 5/2), pale brown (10YR 6/3); interior – black (10YR 2/1), grayish brown (10YR 5/2), dark gray (7.5YR 4/1).

C. SURFACE-ROUGHENED WARE (Fig. 2: 7)
This category includes fragments that have been previousely catalogued as 'pottery for cooking'[29]. The sherds contain vegetal material, pebbles, milimetric quartz and white mica granules (both on the inside and on the outside). A small number of fragments contain shells or grog in the paste. The shells do not seem to be added deliberately, but seemingly originate in the clay sources. It is possible that some of these fragments were intrusions from the Sălcuța layer which overlaps the Vădastra layers.

The outer surface is smoothed or rough, while the inside is more often than not well smoothed (sometimes even burnished) in order to reduce porosity. Many of the sherds making up this category come from secondarily fired pots, as a result of their repeated use on the fire. The surface-roughened ware was divided by us in two groups: 1) Plain; 2) Decorated: barbotine, impressions (made with an object on the rim or on the maximum diameter; impressions made with the finger under the rim), incisions, plastic decoration, finger stripes, combinations between the techniques mentioned above. The sherds belonging to this category have the following colours: exterior – very dark gray (10YR 3/1), light yellowish brown (10YR 6/4), red (2.5YR 5/6); interior – black (10YR 2/1), grayish brown (10YR 5/2), reddish brown (5YR 5/4).

For the purpose of this study the surface-roughened sherds decorated with spiral incisions were treated separately. Colours: exterior – black (10YR 2/1), dark gray (10YR 4/1), light brown (7.5YR 6/4); interior – very dark brown (10YR 2/2), pale brown (10YR 6/3), reddish brown (5YR 4/3).

The core colours of the sherds from the sample are black (10YR 2/1), dark gray (10YR 4/1) and gray (10YR 5/1); rarely – grayish brown (10YR 5/2), pale brown (10YR 6/3) and reddish brown (5YR 5/4).

All bases are flat. Some of them are painted with red ochre (excised decorated pots), others are decorated with incised lines or have textile impressions (Fig. 3). In the previous articles concerning Vădastra pottery technology Mateescu used the terms 'Vădastra 1' for the plain burnished and channelled pottery and 'Vădastra 2' for the excised pottery. In the present article we use the same conventional terms but we do not imply a chronological difference between these pottery groups.

Wall thickness

We have used the following conventional groups:

1. thinner than 4 mm;
2. 4 – 6.9 mm;
3. 7 – 9.9 mm;
4. 10 – 15 mm;
5. over 15 mm.

The 'Vădastra 1' pottery is related especially to groups 2 and 3. At the same time, these pottery categories are the only ones containing sherds thinner than 4 mm (e.g. cups). The rest of the pottery categories are related above all to groups 3 and 4. Sherds over 15 mm occur only in the case of surface-roughened pottery and in that of

[29] Gâță, Mateescu 1992a.

the 'Vădastra 2' pots. Some of the latter have an average thickness of about 19 mm and probably come from large storage vessels.

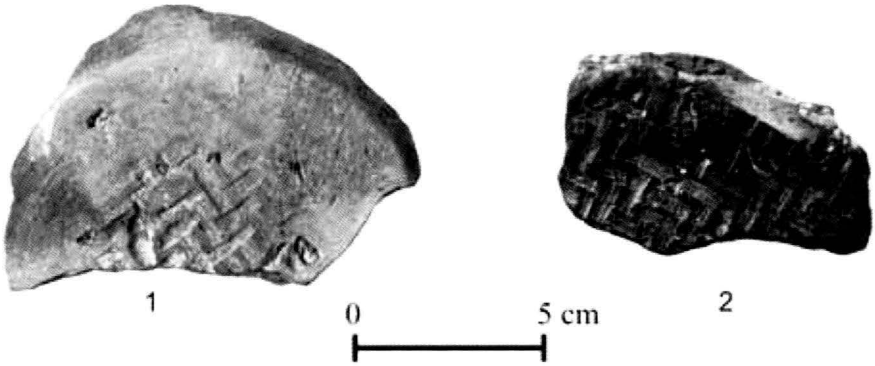

Fig. 3. Vădastra. Bases with textile impressions

Clay sources

If the potters used local raw matter for modelling their pottery, they must have taken the clay from near the settlement, namely from the outcrops in the Obârşia stream bed, from the outcrop in Dealul Cişmelei, the outcrop in Malul Roşu or from the pits dug in the settlement. All that material ranges from loamy sand to loam, with a clay content from 8 to 28 %, a quartz content from 20 to 55 % and a carbonate content from 1 to 54 %.

The distribution of some samples analysed according to the ratio between the X-ray diffraction lines intensity of the quartz (4.26 KX) and calcite (3.03 KX) appears bimodal and asymmetrical with two maximum intervals 4-5 and 13-14 (Fig. 4).

Except for the values over 22, all the pottery fragments overlap local sources and suggest that pottery was modelled with local clay. In Figure 4, the locations corresponding to the sources are grouped as follows: under the value 1 the samples with a high content of carbonates from the pits dug in the settlement[30]; the interval 1-10 includes the samples from the Obârşia stream bed; the 10-17 one corresponds to Dealul Cişmelei and at 22 there is a sample from Malul Roşu. The last interval over the value 20 has few samples and suggests that only incidentally clays from this location could have been used.

Most pottery fragments range between 0-17, except for some surface-roughened sherds with spiral incisions and some 'Vinča style' pottery samples. This distribution could suggest that at least some of these are not made with local clay and could belong to pots brought in the settlement.

The locations corresponding to the pots and figurines are mixed up in the same areas and prove that the same clay sources were used both for pots and figurines.

The locations of all three pottery categories from our sample lie in the same areas and prove that they have the same sources, but suggest that the clay chosen for the burnished wares bore as few large sand granules as possible.

The 'Vădastra 1' pottery quartz-carbonate ration is high, that is from 1 to 23, suggesting, by comparison with the 'Vădastra 2' pottery, more clay attempts for pot

[30] Protopopescu-Pake *et al.* 1969.

modelling. Indeed, the 'Vădastra 2' pottery ranges between 1-15 more restrictedly. Surface-roughened pottery ranges between 1-16 and has the same sources as plain burnished pottery and decorated burnished pottery.

By comparing the pottery locations with those of the sources one might say that the clay sources were fewer for the excised pots, as there were used above all the sandy

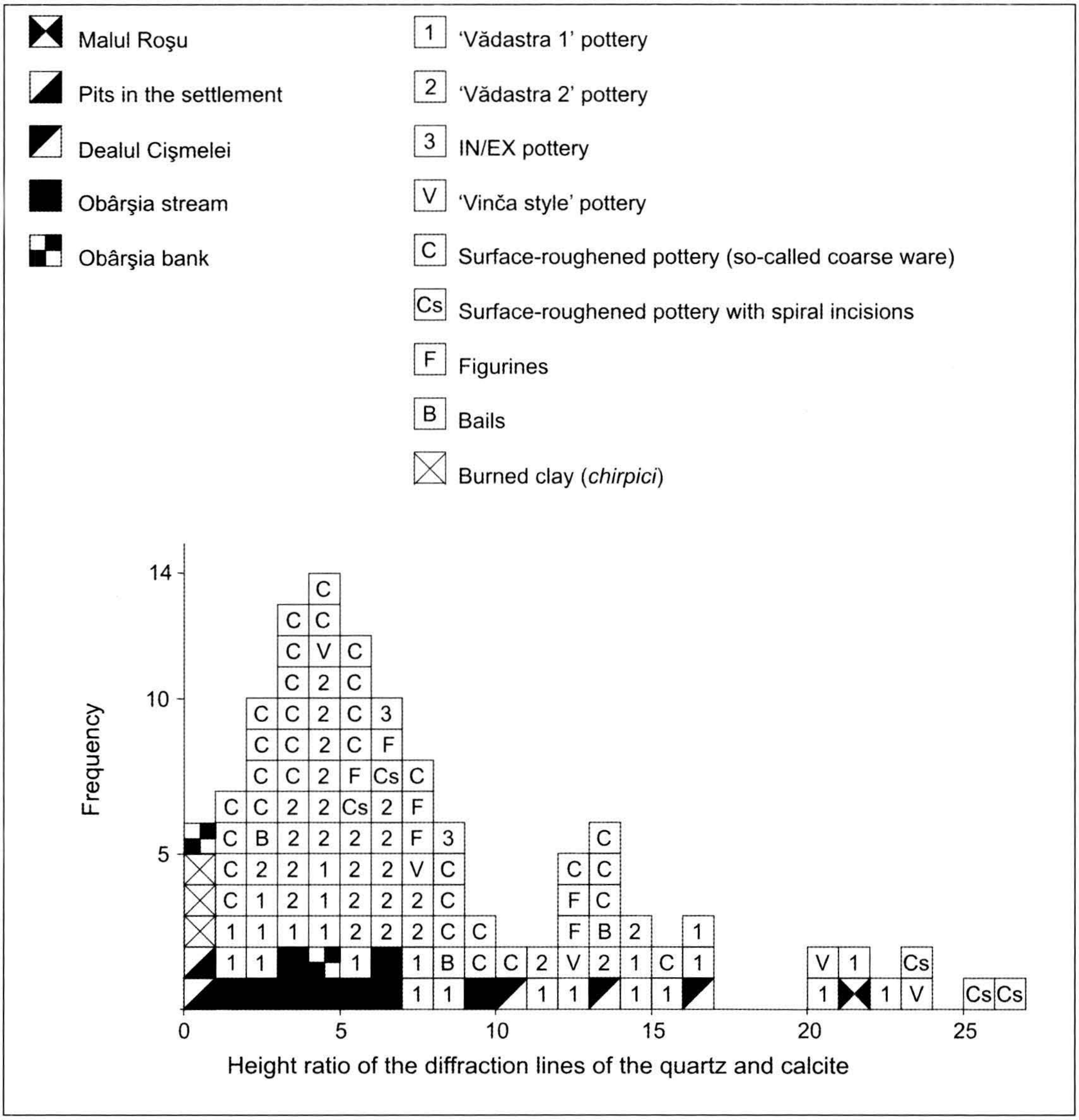

Fig. 4. The distribution of some clay and ceramic samples from Vădastra according to the ratio between the X-ray diffraction lines intensity of the quartz and calcite.

loam from Obârşia stream bed, and more rarely the clay from the outcrop in Dealul Cişmelei, as already specified for the surface-roughened pottery[31].

The four 'Vinča style' sherds analysed are two in the Vădastra sources area and two at values over 20. The position of the latter two might suggest that they belong to pots brought to the settlement.

[31] Gâță, Mateescu 1992a.

Of the five samples of surface-roughened pottery with spiral incisions, two belong to the Vădastra sources interval, as the other three belong to the 23-27 interval not found at the sources from the settlement.

The distribution of the analysed samples according to the ratio of the quartz and calcite diffraction lines intensities points to three groups. The 0-11 interval corresponds to the sources from the Obârşia stream bed and from the pits in the settlement, next to all the pottery and adobe types, containing 74 % of the pottery fragments. The second interval, ranging between 11-17, includes only 18 % of the ceramics, containing 'Vădastra 1' sherds, surface-roughened sherds, less 'Vădastra 2' fragments and only one 'Vinča style' sherd. The last interval – with only 8 % of the pottery – contains only 'Vădastra 1' sherds, surface-roughened fragments with spiral incisions and 'Vinča style' ones. All these analytical data prove that the potters had used more often the sources from the Obârşia stream bed.

In order to determine more exactly the sources of raw matter used for modelling of Vădastra Neolithic pottery[32], the analysed samples were distributed according to the ratios of the magnesium/iron and calcium/strontium concentrations from a hydrochloric acid 6N. The diagram obtained (Fig. 5) divides the samples into three areas according to the calcium/strontium ratio limited to the values 275 and 555.

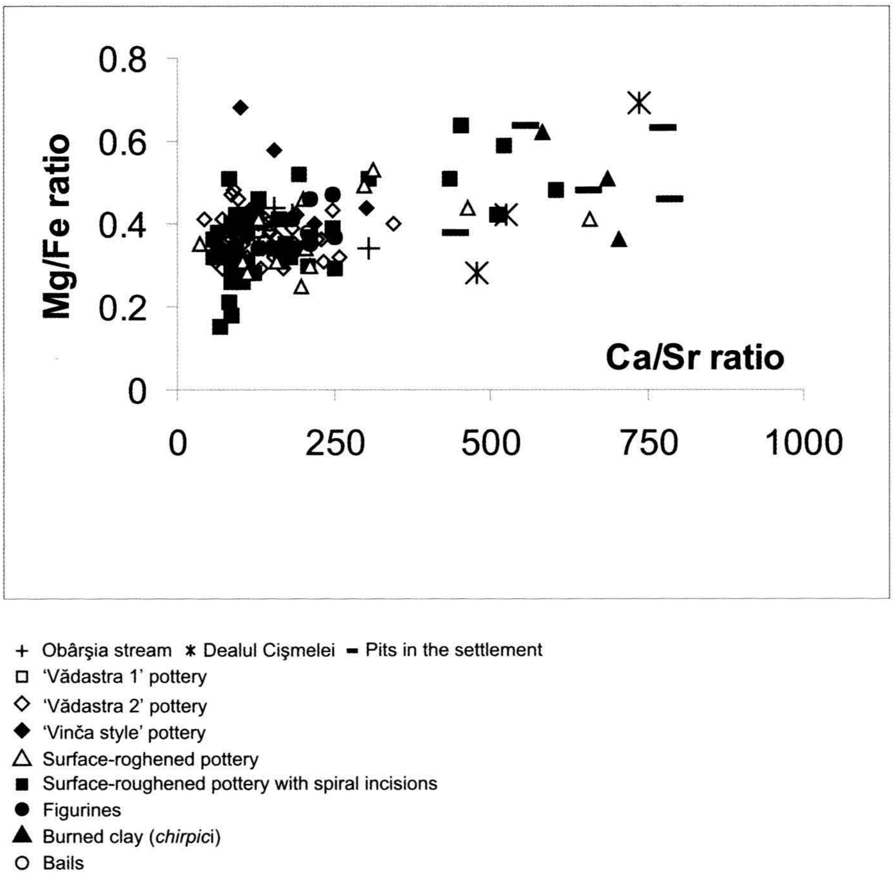

Fig. 5. The distribution of the clay sources and ceramics from Vădastra, according to Mg/Fe and Ca/Sr ratios.

[32] Gâţă, Mateescu 1992a.

The first area includes the sources from the Obârşia stream bed and all the types of Vădastra pottery. The density of the pottery samples is higher and represents 91 % of the analysed fragments. The second area (7 %) includes surface-roughened fragments, 'Vădastra 1' sherds, next to sources from Dealul Cişmelei and from the pits in the settlement. The third area (2 %) includes a 'Vădastra 1' sherd, a surface-roughened sherd and two adobe samples.

The first area includes two 'Vinča style' pottery locations, at values of the magnesium/iron ratio over 0.55, and other three locations corresponding to the surface-roughened pottery with spiral incisions at magnesium/iron values under 0.21. These sherds could come from pots brought to the settlement. But these pottery groups also occur in the 'dots cloud' of the pottery from Vădastra.

The chemical and mineralogical data prove that the raw matter necessary for modelling the pots were taken from outcrops in the close vicinity of the settlement. More often than not, the sandy clay from the Obârşia stream bed was used, and less that from the outcrops in Dealul Cişmelei. Instead, it is less likely for the material from the pits in the settlement to have been used for the pottery, as the sherds examined by microscope do not contain many lime concretions as the material from the pits. However, the latter was used for building the house found in the Vădastra II layer. Meanwhile, the use of the clay from Malul Roşu is unlikely, as no fragment contains iron in such a high concentration as this material.

The suitability of the local clay sources researched is confirmed by the mineralogical composition of the clayey fractions containing about 10-12 % smectite, 9-11 % illite and 0.5-1 % kaolinite. The smectite content is optimal to give a paste with a very good plasticity for modelling pottery. The other components of the clay degrease the paste sufficiently to prevent deformation and cracking of the pots at firing. The experimental reasearches carried out at Vădastra proved that the local sources have very good modelling and firing properties: 'The suitability of the locally available clay has been excellently demonstrated. The clay can be obtained from the bed of the local river where it occurs in abundant quantities. It needs little working other than the breaking down of lumps within the clay. It is sufficiently coarse with enough naturally occurring inclusions to allow water to escape from the clay during firing. The clay is therefore naturally robust and this is demonstrated by the fact that the clay balls and discs were fired from wet in a bonfire with a rapid temperature rise.[33].

At the same time, it should be taken into account that in pre-industrial societies, both the clay and the temper were not chosen only out of utilitarian criteria. For instance, in some cases the clay sources are chosen out of social and political considerations. In a village in Ecuador (Conambo), the members of the Achuar political faction use – mainly – the clays from Yauna, while the members of the Quichua faction use clays from Gloria and more rarely Yulanda[34]. In Paradijon (a small barrio in the town of Gubat, Southern Luzon, the Philippines), people identify three textures of clay called *barasan*, *himolot* and *salado*, and four colours of clay – white, red, black, and green[35]. According to Mark A. Neupert '[m]en conduct probes within a clay source to find the best clays, the choicest being the white himolot; different sources are ranked in quality, based on the amount of the choicest clays. Although the men know which sources are superior, sociopolitical factors dictate which source they use, even if it contains clays of inferior quality[36].

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[33] Gibson 2002.
[34] *apud* Costin 2000, p. 386 and Table 1.
[35] Neupert 2000, p. 253.
[36] Neupert 2000, p. 253.

As noted by Oliver Gosselain, '[...] the real issue is to realize that every step of a technical process – be it pottery making or any other mundane and 'functional' activity – may become the locus of a symbolic discourse.'[37] Clay selection, tempering, firing or post-firing operations should not be understood only in functional terms but also as 'full cultural products'[38]. We agree with Gosselain that '[...] the question is not so much to determine where function stops and symbol (or style) begins, but to be aware of their remarkable intricacy[39].

Tempering

The preference of the clays from the Obârşia stream bed is explained *inter alia* by their light modelling, as the winter frost breaks the aggregates, and allows a lighter tempering of the paste when water is added.

The tempering is thorough and the quartz granules are spread rather evenly in the mass of the pottery. In the thin sections occur many voids produced by the firing of the cut vegetal material added as temper. There is no sand degreasing and no sand deposits occur close to the settlement.

The clay tempering has been done by portions. To a certain amount of clay water was added gradually until a consistent paste formed, by stirring all the time until a full wetting of the material. Then the paste ball was flattened and a cut vegetal mass was added, the margins were folded, an operation repeated more times. One recognizes in the thin sections such a procedure by a parallelism of the elongated voids in the pottery mass obtained by firing.

Modelling

Each pot was modelled by sticking flattened patches after they had been well tempered. First they modelled the bottom of the pot from a single piece, then the patches were overlapped, pressed and modelled. The modelling of the pot by adding flat strips is emphasized by the rolling voids between the two overlapped patches, occurring sometimes after the firing of the pot. Here the patch heightening the pot was added inside and the outer part was flattened upwards.

The fact that the modelling of the walls of the pots was carried out with patches tempered and degreased before the sticking is revealed by the systematic differences between the average values of some properties of the bottoms and the rest of the pots. Thus, the average of the porosity index (the ratio between porosity and the average thickness of the sherds, that is a measure of the amount of the added vegetal mass), is lower for the pot bottom than for the rest of the pot, in the case of 'Vădastra 1' and 'Vădastra 2' pottery (Fig. 6). This pattern suggests that the potters in the Vădastra Neolithic settlement deliberately modelled the bottoms of the pots with a lower porosity than for the rest of the pots, probably due to the firing conditions of the firing spaces where the bottoms of the pots were less stressed thermically. The potters modelled the pottery giving it certain shapes, thicknesses, diameters and vegetal mass addition according to a certain pattern, that they observed between certain tolerance limits.

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[37] Gosselain 1999, p. 221.
[38] Gosselain 1999, p. 221.
[39] Gosselain 1999, p. 221.

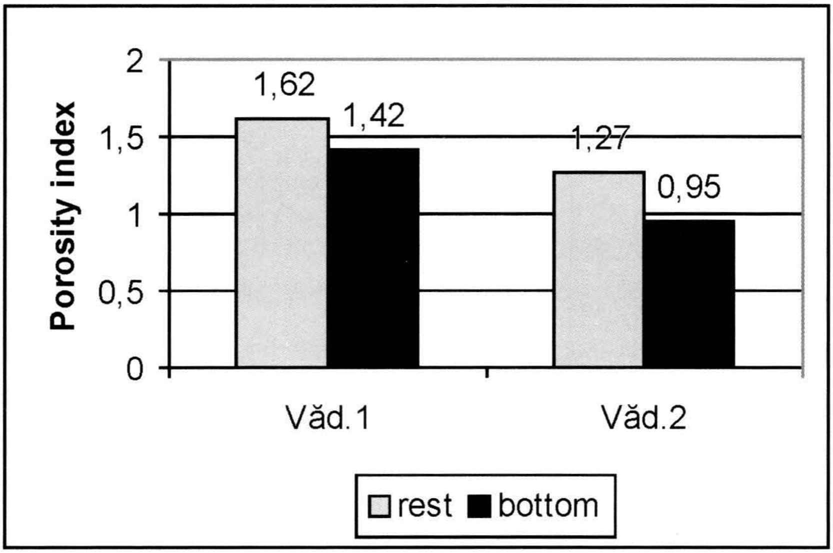

Fig. 6. The porosity index of vessel parts for 'Vădastra 1' pottery (Văd. 1) and 'Vădastra 2' pottery (Văd. 2) from Vădastra.

In order to follow a possible evolution of the Vădastra pottery the sizes and porosity properties of the various pottery categories uncovered in the settlement were compared. Table 1 presents the averages of the thickneses, porosity index and diameters of the sherds, as well as the variation coefficients of these averages. In order to better realize of the possible evolution that could have resulted from the differences between the average values, we established the following groups: 1. plain burnished pottery; 2. channelled pottery (vertical, oblique and circular channellings); 3. excised pottery; 4. IN/EX pottery; 5. 'Vinča style' pottery; 6. surface-roughened pottery; 7. surface-roughened pottery with spiral incisions. The table presents separately the properties of the bottom parts of the pots. The pottery groups separated in this manner were rowed according to the increase in the average thicknesses of the fragments.

The thickness averages of the surface-roughened pottery with spiral incisions, IN/EX pottery and 'Vinča style' pottery are located between the 'Vădastra 1' and 'Vădastra 2' pottery. The same is the case with the rest of the surface-roughened pottery.

As the average thickness of the walls of the pots increases, also the average diameters increase from 130-150 mm in the case of the 'Vădastra 1' pottery, to 258 mm in that of the 'Vădastra 2' pottery. The surface-roughened pottery with spiral incisions IN/EX pottery and 'Vinča style' pottery have average diameters about 210 mm.

The average porosity ranges between 9 and 10.7 even at the averages of the 'Vădastra 1' pottery, without a systematic variation as related to the thickness of the sherds. It suggests that it was a notion unknown to the potters, not belonging to the pot modelling patterns. Instead, the vegetal mass addition as shown by the porosity index decreases with the increase in the thickness from values of 1.72-1.32 in the case of the 'Vădastra 1' pottery, to 1.13 in that of the 'Vădastra 2' pottery. The IN/EX pottery and 'Vinča style' pottery have intermediate values.

The surface-roughened pottery, with a porosity index of 1.16, has a smaller vegetal mass addition, probably meant for liquid heating, as proven by the oxidizing secondary firing in many fragments of this category.

Wares	No. of sherds	Thickness		Porosity		Porosity Index		Diameter (mm)	
		Average	V.C. %	Average	V.C. %	Average	V.C. %	Average	V.C. %
Pottery decorated with oblique channellings	49	6.5	25.3	10.7	21.3	1.72	28.8	148	28.3
Plain burnished pottery	107	6.83	34.4	10.3	25.6	1.63	36.1	132	44.6
Pottery decorated with vertical channellings	70	6.95	23.8	10.2	20.9	1.54	29.3	153	34.7
Pottery decorated with circular channellings	23	7.09	19.1	9	22.1	1.32	20	141	27
Surface-roughened pottery decorated with spiral incisions	100	8.5	20.6	9.7	19.9	1.18	24.6	212	26.5
IN/EX pottery	59	8.66	26.4	10.4	19.6	1.27	29.8	205	46.5
'Vinča style' pottery	75	8.66	21.9	10.9	21.3	1.34	34.2	217	42.2
Surface-roughened pottery	120	9.38	21.7	10.6	24.6	1.16	27.1	208	37.2
Excised pottery	237	9.78	25.8	10.3	17.1	1.13	32.1	258	41
Bases: IN/EX pottery	9	11.1	23.2	9.94	13.1	0.93	23.8	84	50.3
Bases: excised pottery	30	11.3	29.8	10.4	13.3	0.99	32.7	97	47.6
Bases: plain burnished and channelled pottery	26	12.2	22.8	11.1	18.9	0.96	27.5	72	35.4

Table 1. Wall-thickness, porosity index and diameters of the sherds (V.C. = variation coefficient of the average).

The bottom is always thicker, while the porosity index and diameter of the bottom are smaller than the properties of the rest of the pot. It results that in the settlement of Vădastra conical and biconical pots prevail, having thicker bottoms than the rest of the pots and a smaller vegetal mass addition. The variation coefficients of the average thickness ranges between 19.1 and 34.4, having a rather constant thickness of the walls of the pots over the whole existence of the Neolithic settlement.

Comparing the various pottery groups, the average diameters of the pots increase from 132 mm to 258 mm, while their variation coefficients have average values from 26.5 to 46.5. There are no systematic variations in the row of the values, which proves that the range of the forms was maintained over the Vădastra Neolithic.

Wares	No. of sherds	i = f (s)			d = f (s)			m = f (s)		
		R 1	R 2	F	R 1	R 2	F	R 1	R 2	F
Plain burnished pottery	107	0.707	0.674	87.2	0.620	0.616	85	0.33	0.328	12.6
Pottery decorated with vertical channellings	70	0.710	0.658	52.1	0.417	0.401	13	0.541	0.45	12
Pottery decorated with oblique channellings	49	0.732	0.632	43.2	0.630	0.588	24.9	0.541	0.45	12
Pottery decorated with circular channellings	23	0.556	0.543	8.74	0.16	0.18	0.51	0.549	0.463	18.6
Excised pottery	237	0.848	0.794	40.1	0.524	0.519	86.8	0.14	0.12	3.54
IN/EX pottery	59	0.777	0.701	55.2	0.421	0.42	12.2	0.233	0.06	0.18
'Vinča style' pottery	75	0.756	0.698	69.3	0.58	0.502	24.6	0.393	0.343	9.71
Surface-roughened pottery	120	0.603	0.536	47.7	0.359	0.354	16.9	0.313	0.298	11.5
Surface-roughened pottery decorated with spiral incisions	100	0.638	0.616	59.8	0.507	0.504	33.4	0.263	0.235	5.73
Bases: plain burnished and channelled pottery	26	0.889	0.746	30.1	0.437	0.433	8.64	0.556	0.542	10
Bases: excised pottery	30	0.920	0.891	157.4	0.17	0.06	0.08	0.732	0.604	16.1
Bases: surface-roughened pottery	38	0.887	0.83	79.5	0.626	0.612	21.5	0.548	0.529	14

Table 2. The correlation coefficients of the equations with thickness (s), porosity index (i), diameter (d) and modelling index (m). R1 = the maximum value of the correlation coefficient; R2 = the linear correlation coefficient; F = the Fisher value of the linear relation.

The average porosity indexes continuously decrease from the 'Vădastra 1' pottery to 'Vădastra 2' pottery, and suggests that the potters used less vegetal material as temper in the case of the latter.

The variation coefficients of the average indices range between 20 and 36.1 %, showing tolerances in vegetal mass proportion added to the bottoms and the rest of the pots according to the researched categories.

In order to see in a more detailed manner the modelling patterns of the pots, properties of the sherds of various Vădastra pottery groups were compared. Thus, they were correlated to the thickness of the sherds – the porosity index, diameter and modelling index expressed by the standard deviation of the calculated averages representing an assessment of the evenness of the thickness of the pot walls. The tightest link is obtained between the porosity index and thickness of the walls of the pots for all the pottery categories analysed (Table 2).

According to the correlation coefficients R1, the proportion of the vegetal mass assessed by the porosity index, is approximately the same as related to the thickness of the 'Vădastra 1' pottery (0.56-0.73), the surface-roughened pottery, the 'Vinča style' pottery and the IN/EX pottery (0.60-0.78), but tighter for 'Vădastra 2' pottery (0.85). That suggests a smaller more thoroughly dosed amount of vegetal mass as related to the thickness of the 'Vădastra 2' sherds. The best relationships are the power ones and have a rather marked curvature radius as proven by the differences between R1 and R2. The bottoms of the pots have correlation coefficients R1 over 0.88, proving the care for adding vegetal degreaser. Also in this case, in the excised pottery one can notice more care for degreasing than in the other pottery groups.

In order to exemplify the distribution of the locations in a porosity index–thickness diagram we represented the 'Vădastra 1' pottery (Fig. 7). The representative locations are grouped along a power curve under the form of a dot band 1.14 units wide, representing a tolerance of 78 % as related to the average value 1.59 for the 249 tested samples. The high tolerance can be explained because this pottery was made for many generations.

Likewise, for the 'Vădastra 2' pottery, the porosity index–thickness diagram (Fig. 8) has the locations along a power curve under the form of a band 0.67 units wide for an average value of 1.13, representing a tolerance of 59 %. By comparing the tolerances of the pottery groups presented, there results a technological continuity between the 'Vădastra 1' and 'Vădastra 2' pottery.

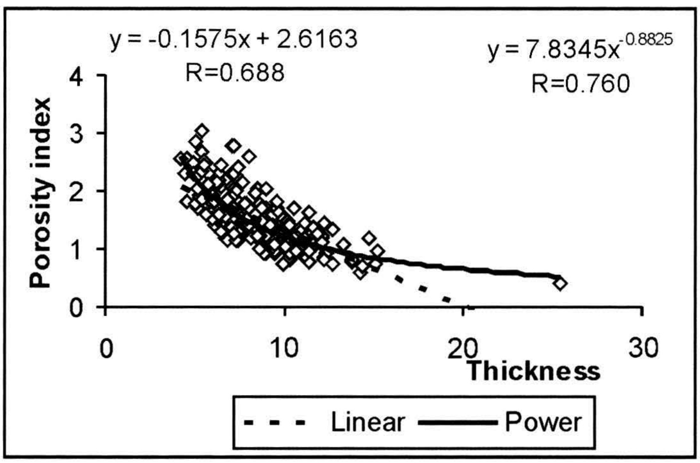

Fig. 7. The relation between porosity index and thickness for 'Vădastra 1' pottery from Vădastra

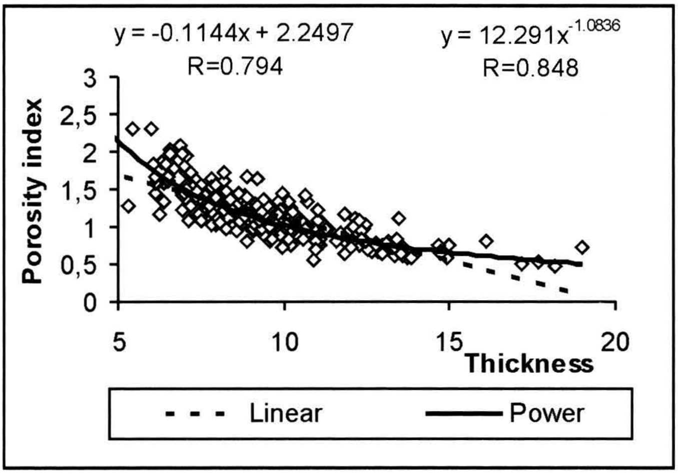

Fig. 8. The relation between porosity index and thickness for 'Vădastra 2' pottery from Vădastra.

Attention should be paid to surface-roughened pottery, modelled during both 'phases' (Fig. 9). In the diagram, the representative locations are spread, the correlation coefficients lower and the tolerance higher than 86 %. This pottery is in most part fired oxidizingly on larger outer thicknesses, proving that the pots were fired on an open firing like that of the fireplaces. That suggests that many pots from this category were used for cooking. It is possible for the higher dispersion of the location in Fig. 9 to come from the secondary firing.

The other pottery categories maintain a tighter relationship between the porosity index and sherd thickness best expressed by a power equation with correlation from 0.556 for 'Vădastra 1' pottery, to 0.848 for 'Vădastra 2' pottery suggesting more care for latter one in adding the vegetal temper. When modelling the bottoms of the pots the relation is even tighter with very high correlation coefficients (0.887-0.920).

In Table 1 (*vide supra*) it can be seen that the diameters of the sherds increase with their thickness. The relation is tighter for 'Vădastra 1' pottery (R1 = 0.630) and looser for surface-roughened pottery (R1 = 0.359). In many cases the correlation coefficients are higher, obtained at parabolic relations, being very close as values to those of linear relations.

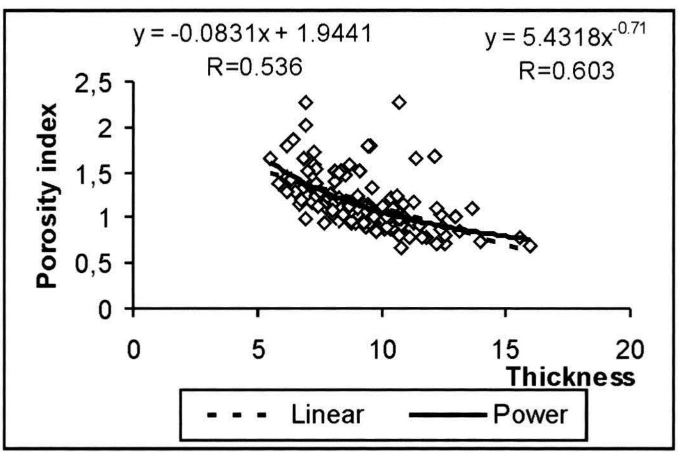

Fig. 9. The relation between porosity index and thickness for surface-roughened pottery from Vădastra.

In Fig. 10 we present the relation between diameter and thickness for 'Vădastra 2' pottery. The dispersion of the location increases with their thickness. For an average diameter of 258 mm the tolerance is 73 % and increases at the same time with the diameter. That increase proves that for the excised pots, the diameter–thickness ratio is lower as the pots are larger.

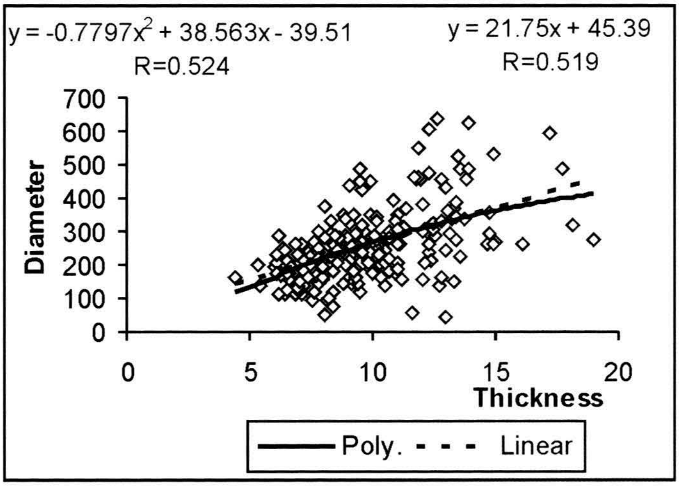

Fig. 10. The relation between diameter and thickness for 'Vădastra 2' pottery from Vădastra.

The IN/EX pots have preserved this pattern approximately (Fig. 11) with tolerances up to 300 %.

In order to assess the even thickness of the walls of the pots the modelling index was assessed as a standard deviation of the individual measurements for the calculation of the sherds thickness[40]. The tightest modelling index–thickness relation is the parabolic one, but this relation is much looser than the porosity index–thickness and diameter–thickness ones (Fig. 12). That proves that the potters were not concerned with modelling pots with walls of the same thickness.

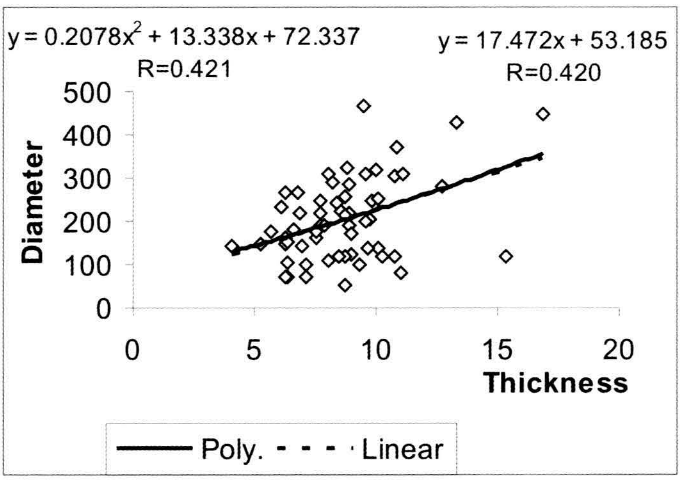

Fig. 11. The relation between diameter and thickness for IN/EX pottery from Vădastra.

[40] Gâță *et al.* 1997.

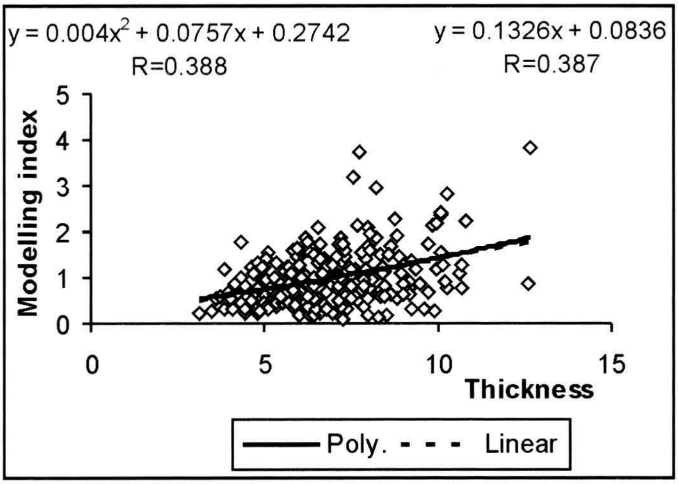

Fig. 12. The influence of the sherd thickness on the modelling index for 'Vădastra 1' pottery from Vădastra.

The fact that the average value of the modelling index is lower in the case of the 'Vădastra 2' pottery sugests that the potters payed more atention to modelling this kind of vessels (Table 3).

Wares	No. of sherds	Modelling index		Minim value	Maxim value
		Average	V.C. %		
Plain burnished pottery	107	0.89	71.5	0.16	3.75
Pottery decorated with vertical channellings	70	1.21	52.6	0.11	3.28
Pottery decorated with oblique channellings	49	1.06	58.5	0.26	3.18
Pottery decorated with circular channellings	23	1.1	32.3	0.47	2.17
Excised pottery	237	0.98	63.3	0.15	4.32
IN/EX pottery	59	0.95	65.2	0.57	4.48
'Vinča style' pottery	75	0.95	86.6	0.14	4.34
Surface-roughened pottery	120	1.07	78.5	0.5	4.57
Surface-roughened pottery decorated with spiral incisions	100	1.04	74	0.23	5.53
Bases: plain burnished and channelled pottery	26	1.41	48.9	0.45	3.28
Bases: excised pottery	30	2.6	70.2	0.27	5.33
Bases: surface-roughened pottery	38	2.19	45.8	0.58	4.49

Table 3. The modelling index of the various pottery groups (V.C. = variation coefficient of the average).

Nevertheless, these averages of the modelling indexes are of the same size order over the entire Vădastra Neolithic with values between 0.89 and 1.21. The variation coefficients have high values from 32.3 % to 86.6 % both at the bottom, and the rest of the pot. The surface-roughened pottery has modelling indexes similar to burnished pottery, confirming that the evenness of the walls thickness was maintained instinctively.

The results of the physical tests carried out help us figure out the working method and sequence of operations for the manufaturing of the pots. In the first place, the potter brought the clay for the pots from the outcrop from which (s)he was accustomed to take it. If the clay had too many large quartz granules, (s)he used it only for surface-roughened pots. When modelling the bottom of a surface-roughened pot (s)he made it as rounded as possible, by thickenning the adjacent portion between the bottom and body of the pot. In the case of the burnished pottery, the interior surface treatment (burnishing) was more rigorous for the plain burnished and channelled pots, and more superficial for the excised pots, which suggests that the excised pots were not used for liquids or food that could have stuck to the rough spots of the inner walls. The bodies of the pots were modelled and evened in a similar manner for the entire Vădastra pottery. After a thorough tempering of the clay with water – with a view to obtaining a consistent paste – they used to flatten the clay ball and add cut vegetal mass as a degreaser. Then, the paste was folded more times, so that as few as possible remains of plants appeared at the surface of the flattened patch. After the modelling and evening of the bottom, the newly tempered flattened patch was laid upon the adjacent margins of the bottom, the wall of the pot was pressed and modelled. The potter bore in mind first of all the proportion of degreasing addition to the clay as related to the thickness of the pots walls. Secondly, the potter used to proportion the thickness of the walls according to their diameter. The potters were not concerned with the evenness of the thickness of the pots walls, that were instinctively manufactured almost of the same thickness after the modelling.

Finishing the pots for firing

The pots were left to dry at the environmental temperature, laid on dry earth or on rugs. In a few cases, on the bottoms of the pots the pattern of the rugs was imprinted (see Fig. 3). After a partial drying, the fine pots were wetted by sprinkling them with a fine diluted suspension, made out of the same clay as the pots, and obtained by the sedimentation of the suspension, and the decantation of the fine part. This way, at the surface of the pots a thin slip formed. Then, the pots were decorated. After being dried out, the pots were again sprinkled a little, and the undecorated surfaces were burnished/polished with smooth polishing stones. More often than not, these stones were of microcrystalline quartz, as proven by their X-ray diffraction diagrams. Then red ochre was applied, especially on the excised pottery[41]. Sometimes, on the 'Vădastra 1' pottery red colour was applied also after firing[42]. The white colour is given by the cut limy concretions, that the potters got from the Obârşia stream bed[43].

Firing

Once finished and dried out, the pots were fired on open firing, in firing spaces with non-constant temperature, between 400 °C and 550 °C. The firing was incomplete, so that on the outside the pottery mass reached till 600 °C, while on the inside it barely reached 200 °C in the pots with thick walls. These levels of temperature can be recognized by the constant occurrence of the 10 kX diffraction line decomposing towards 680 °C, the presence or lack of the infrared absorption band from 3690 em^{-1} of the kaolinite decomposing at 450-500 °C and by the ratio of the intensity of the diffraction lines from 10 kX and 7.15 kX ranging between 100 °C and 450 °C. After firing and cooling, the pots were burnished/polished again, as proven by the lustre, and the orientation of the mica particles at the surface of the sherds. Unlike burnished pottery, many of the surface-roughened pots were fired secondarily unevenly, in oxidizing atmosphere, at temperatures over 550 °C.

[41] During the excavations ochre balls for pottery painting were found.
[42] Gâță, Mateescu 1999-2001.
[43] Gâță, Mateescu 1987; 1992b.

In the settlement of Vădastra several pottery firing pits were found, all of them in the Vădastra II layer[44]. In the literature they were also called 'simple kilns[45]. Till now we have found informations about nine firing pits in Mateescu's documentation ('Mateescu Archive' – Institute of Archaeology, Bucharest):

- *1959 excavation season.* Rounded shape firing pit with diameters of 0.56 × 0.51 m. Burning traces have been preserved on the margins (5-6 cm thick). On the bottom of the pit the burnt area has been better preserved in the northern part and is 2-3 cm thick.
- *1960 excavation season.* Rounded shape firing pit with diameters of around 1 m × 0.80 m. Burning traces have been observed on the bottom and the eastern margin of the pit.
- *1961 excavation season.* A large part of a firing pit was destroyed by a Medieval pit-house (pit-house no. II). Burning traces were observed on the bottom of the pit (1-2 cm thick) and on the margins (around 2 cm thick).
- *1962 excavation season/squares 5 and 6.* Two firing pits with rounded shapes were found. One of them has diameters of around 0.69 × 0.70 m and a depth of around 0.23 m, while the other one has diameters of around 0.85 × 0.88 m and a depth of around 0.24 m. The burning traces are between 3 and 8 cm thick.
- *1962 excavation season/square 13.* One firing pit destroyed by the pit from squares 13 and 43. The burning traces are 5-6 cm thick.
- *1962 excavation season/square 44.* Rounded shape firing pit with a diameter of around 0.55 m and a depth of around 0.14 m. The preserved burning traces on the margins are around 3 cm thick. Only scarce burning traces have been preserved on the bottom of the pit.
- *1969 excavation season.* Two firing pits with rounded shapes were found in close proximity. One of them has a diameter of 0.65 × 0.43 m and a depth of around 0.20 m. The burning traces are around 6 cm thick on the north-eastern margin. The other one has a diameter of 0.70 × 0.60 m and a depth of around 0.29 m. On the margins the burning traces are between 3 cm (eastern part) and 6 cm (north-western part) thick, while on the bottom – 3 cm.

At the same time, a pottery firing kiln was uncovered during the 1956 campaign. The pit of the kiln was dug down to 0.70-0.80 m deep, it had an almost round shape and a maximum diameter of 0.75 m. The largest part of the firing chamber walls was destroyed. The coal found prove that the wood was of hard essence: some of it was tested and proved to be from oak-tree (*Quercus sp.*)[46]. Taking into account the fragmentary state of the kiln mentioned above, it is not certain that it was used for pottery firing[47].

Whatever, the experimental firings at Vădastra have demonstrated the suitability of Vădastra clay both for bonfire firing and for kiln firing[48].

The potters

According to Mateescu, several Vădastra pottery fragments bear men's fingerprints[49]. Most probably, taking into account the ethnographic examples, in various stages of pot manufacturing – the procurement and processing of clay, the modelling or

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[44] E.g. Mateescu 1970a, p. 58.
[45] Comşa 1981, p. 228.
[46] Mateescu 1959a, p. 68-69; Comşa 1976, p. 355.
[47] See Ellis 1984, p. 130.
[48] Gibson 2002.
[49] E.g. Mateescu 1965, p. 260.

decoration of pots, procurement of fuel, the charging of pits/kilns and so on – participated both men and women[50]. Pot manufacturing is a male and female activity at the same time[51].

Conclusions

The Neolithic pottery from Vădastra was modelled out of local clays. Only some pots could be modelled with clays that are not found in the settlement area. The clays from the Obârşia stream bed were preferred, used in over 74 % of the Vădastra pottery, due to their sandy loam texture, the best smectite content, the low carbonate content, with aggregates crushed by the cold weather frost that makes them easy to be modelled. The modelling patterns are first of all the proportionality between the addition of vegetal mass and the pottery mass, according to the thickness of the modelled wall. The temper addition for the modelling of the bottoms of the pots is always lower than the addition for the rest of the pot. Secondly, the proportionality between the diameter and the thickness of the pots walls was maintained. The potters were little concerned with the evenness of the pots walls that they achieved by intuition. At first the bottom of the pot was modelled out of a piece, then the modelling continued by flattened patches, overlapping the walls of the pot already modelled, pressed and remodelled. After the modelling, the pots were dried out, a thin slip was applied, they were burnished wetly and fired on bonfire in a reduving environment, at about 400-550 ˚C. After the firing, the undecorated portions were burnished/polished again. The thickness of the pots increases with their diameter, but the degreaser addition decreases.

All these observations prove a technological uniformity of the ceramic assemblage found in both Vădastra I and Vădastra II layers.

Acknowledgements:

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The archaeological contexts of the illustrated pottery:

Figure 2. (1) = Analysis no. 1741, Vădastra, 1962 excavation season, square 36, –2.20 m; (2) = Analysis no. 1765, Vădastra, 1966 excavation season, square 6, –1.20 m; (3) = Analysis no. 586, Vădastra, 1963 excavation season, square 22, –0.90 m; (4) = Analysis no. 739, Vădastra, 1971 excavation season, square 1, –1.60/–1.70 m; (5) = Analysis no. 1408, Vădastra, 1973 excavation season, square 4, –1.40 m; (6) = Analysis no. 1200, Vădastra, 1971 excavation season, square 1, –2.00 m; (7) = Analysis no. 2725, Vădastra, 1946 excavation season, bottom of B2.

Figure 3. (1) = Analysis no. 1998, Vădastra, 1962 excavation season, square 45, –0.80/–0.90 m; (2) = Analysis no. 1422, Vădastra, 1963 excavation season, square 8, –1.10 m.

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[50] Wright 1991, p. 198.

[51] Wright 1991, p. 199.

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